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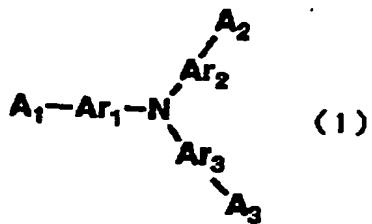
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## **CLAIMS**

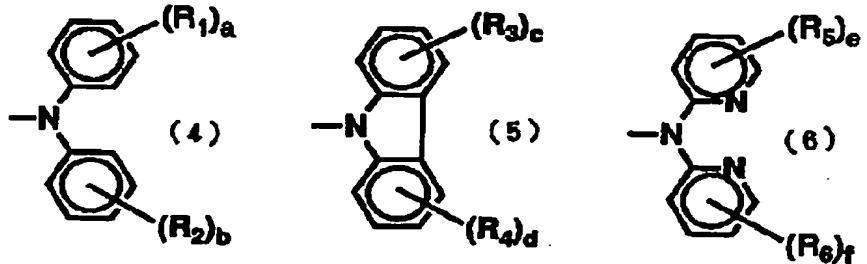
**[Claim(s)]**

[Claim 1] the electroluminescent element which has an electron hole transportation layer containing the luminous layer to which at least one side contains luminescent material and an electron hole transportation ingredient in inter-electrode [ of transparency or a translucent pair ] at least or the luminous layer which contains luminescent material at least, and an electron hole transportation ingredient — it is — as this electron hole transportation ingredient — the following general formula (1) — [Formula 1]



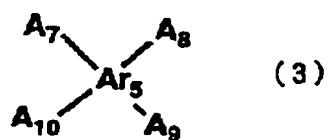
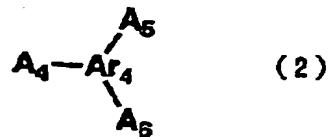
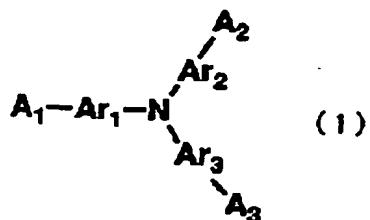
The inside Ar1 of [type, Ar2, and Ar3 express the aromaticity heterocyclic compound radical which contains a with a carbon numbers of six or more aromatic hydrocarbon radical or a with a carbon numbers of four or more hetero atom independently, respectively, and A1, A2, and A3 show independently the radical chosen from following general formula (4) – (6), respectively.

[Formula 2]

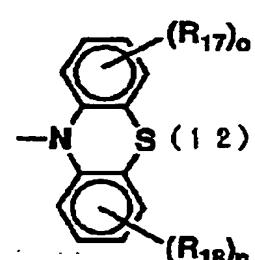
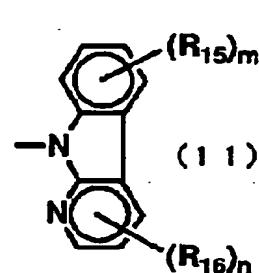
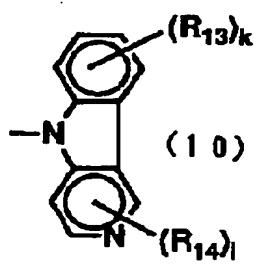
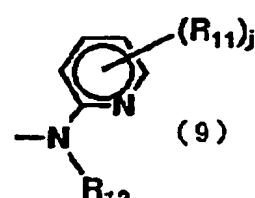
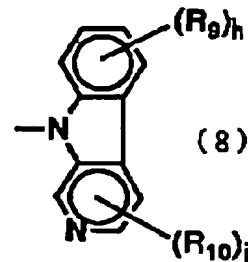
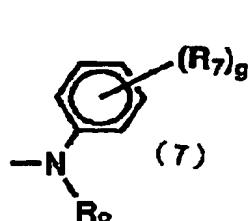
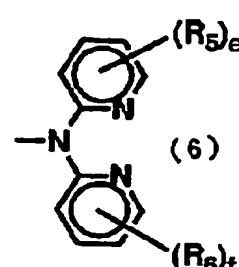
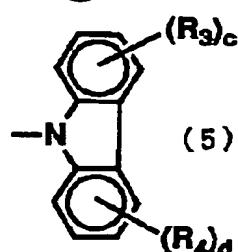
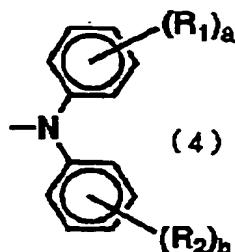


(R1 –R6 is the radical independently chosen from hydrogen, the alkyl group of carbon numbers 1–12 and an alkoxy group, the aryl group of carbon numbers 6–14 and the aryloxy group, the nitro group, and the aromatic heterocyclic compound radical, respectively, and when two or more substituents are in the one benzene ring or a pyridine ring, even if they are the same, they may differ.) a, b, c, d, e, and f are an organic electroluminescent element characterized by the layer which contains at least a kind of aromatic amine compound chosen from the compound expressed with  $0 \leq a, b \leq 5, 0 \leq c, d$  and  $e$ , and integer] of  $f \leq 4$ , and contains an electron hole transportation ingredient being a monolayer, respectively.

[Claim 2] the electroluminescent element which has an electron hole transportation layer containing the luminous layer to which at least one side contains luminescent material and an electron hole transportation ingredient in inter-electrode [ of transparency or a translucent pair ] at least or the luminous layer which contains luminescent material at least, and an electron hole transportation ingredient — it is — as this electron hole transportation ingredient — following general formula (1) – (3) — [Formula 3]



The inside Ar1 of [type, Ar2, Ar3, Ar4, and Ar5 express the aromaticity heterocyclic compound radical which contains a with a carbon numbers of six or more aromatic hydrocarbon radical or a with a carbon numbers of four or more hetero atom independently, respectively. A1, A2, A3, A4, A5, A6, A7, A8, A9, and A10 show independently the radical chosen from following general formula (4) – (12), respectively. [Formula 4]



( $R_1$  –  $R_7$ ,  $R_9$  –  $R_{11}$ , and  $R_{13}$ – $R_{18}$  are the radicals independently chosen from hydrogen, the alkyl group of carbon numbers 1–12 and an alkoxy group, the aryl group of carbon numbers 6–14 and the aryloxy group, the nitro group, and the aromaticity heterocyclic compound radical, respectively, and when two or more substituents are in the one benzene ring or a pyridine ring, even if they are the same, they may differ.) Independently  $R_8$  and  $R_{12}$ , respectively Hydrogen, the alkyl group of carbon numbers 1–12, A radical, a, b, c, d, e which were chosen from the aryl group of carbon numbers 6–10, f, g, h, i, j, k, l, m, n, o, and p, respectively Zero $\leq$ a, b, g $\leq$ 5, 0 $\leq$ c, d, e, f, h, j, k, m and o, p $\leq$ 4, 0 $\leq$ i, The organic electroluminescent element characterized by containing at least a kind of aromatic amine compound chosen from the compound expressed with I and integer] of n $\leq$ 3, and an electron hole transportation layer consisting of a thing which made the high molecular compound distribute this aromatic amine compound.

[Claim 3] The organic electroluminescent element characterized by consisting of a thing to which the luminous layer made the high molecular compound distribute an aromatic amine compound according to claim 2 and luminescent material.

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[Translation done.]

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## DETAILED DESCRIPTION

## [Detailed Description of the Invention]

## [0001]

[Industrial Application] This invention relates to an organic electroluminescent element (following organic EL device). It is related with the organic EL device which used the detailed specific aromatic amine compound for the charge transportation ingredient.

## [0002]

[Description of the Prior Art] Although the inorganic electroluminescent element was used for displays, such as a source of sheet-like light as the former, for example, a back light, and a flat-panel display, etc., it needed the alternating current of the high voltage for making light emit. Recently, Tang and others produced the organic electroluminescent element which has the two-layer structure which made the organic fluorochrome the luminous layer and carried out the laminating of the electron hole transportation layer which becomes it from a triphenyl diamine derivative, and realized a low-battery direct-current drive, efficient, and the organic EL device of high brightness (JP,59-194393,A). Compared with an inorganic EL element, an organic EL device from there being a low-battery drive, high brightness, and the features that in addition luminescence of many colors is obtained easily. Many attempts are reported about component structure, the organic fluorochrome, and the organic charge transportation compound (27 Japanese journal OBU applied physics (Jpn.J.Appl.Phys.)) L269(1988) [the 65th volume (J. Appl.Phys.) of journal OBU applied physics and 3610 pages (1989)], Shirota and others has reported the aromatic amine compound which has star-like molecular shape [chemistry Letters (chemistry letters) 1145 page (1989), 61st spring annual convention 3D337 of the Chemical Society of Japan, 3D338 (1991)]. These aromatic amine compounds have a high glass transition temperature, and operating as a semi-conductor of p mold is reported. These aromatic amine compounds say that the application to charge transportation ingredients, such as organic electroluminescence, is expected. (Three advanced MATERIARUZU (Advanced Materials) No. 11 549 pages (1991), chemistry Letters (Chemistry letters) 1731(1991) No.10.)

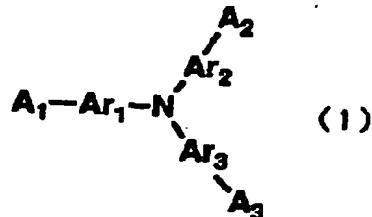
## [0003]

[Problem(s) to be Solved by the Invention] Although the organic EL device reported so far is high brightness, there is a problem that the life of a light emitting device is short. As the reason, a structural change of an organic layer arises by generation of heat of a component, and it is said that it may deteriorate. Therefore, the charge transportation ingredient which constitutes a stable organic layer thermally was called for.

[0004] As a result of considering wholeheartedly the heat-resistant improvement in an organic EL device, by having a specific aromatic amine compound, for example, an aromatic series ring, or thoria reel amine structure in a frame as an electron hole transportability compound, and using the aromatic amine compound in which three or more place nuclear substitution was carried out by the amino group, this invention person etc. formed the uniform organic film, found out that the thermal stability of an organic EL device and the homogeneity of luminescence were improved, and resulted in this invention.

## [0005]

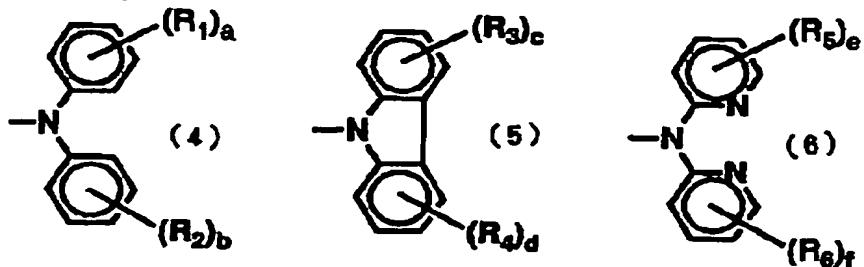
[Means for Solving the Problem] That is, this invention is invention described below. [I] — the electroluminescent element which has an electron hole transportation layer containing the luminous layer to which at least one side contains luminescent material and an electron hole transportation ingredient in inter-electrode [ of transparency or a translucent pair ] at least or the luminous layer which contains luminescent material at least, and an electron hole transportation ingredient — it is — as this electron hole transportation ingredient — the following general formula (1) — [Formula 5]



The inside Ar1 of [type, Ar2, and Ar3 express the aromaticity heterocyclic compound radical which contains a with a carbon numbers of six or more aromatic hydrocarbon radical or a with a carbon numbers of four or more hetero

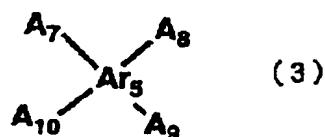
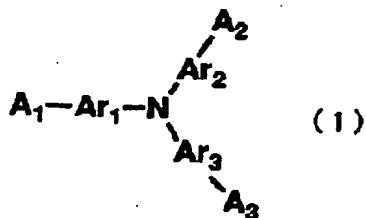
atom independently, respectively, and A1, A2, and A3 show independently the radical chosen from following general formula (4) – (6), respectively.

[Formula 6]

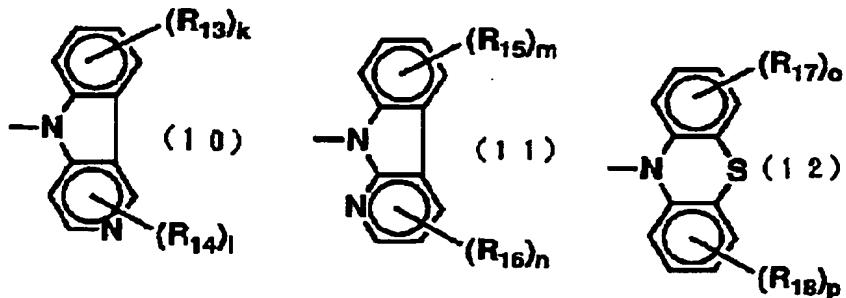
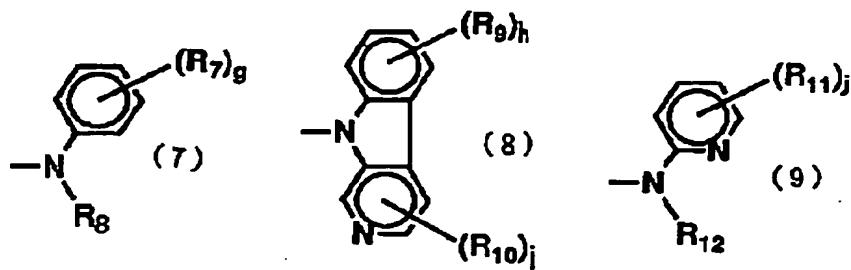
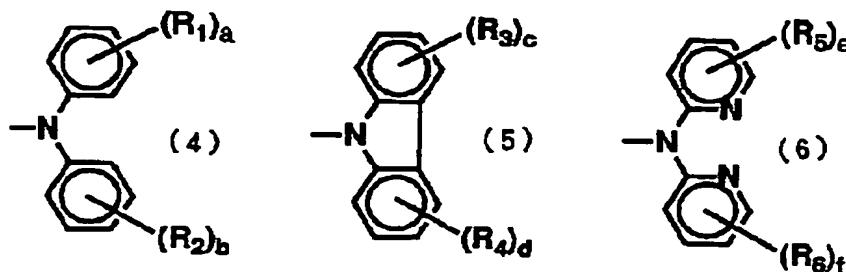


(R1 –R6 is the radical independently chosen from hydrogen, the alkyl group of carbon numbers 1–12 and an alkoxy group, the aryl group of carbon numbers 6–14 and the aryloxy group, the nitro group, and the aromatic heterocyclic compound radical, respectively, and when two or more substituents are in the one benzene ring or a pyridine ring, even if they are the same, they may differ.) a, b, c, d, e, and f are an organic electroluminescent element characterized by the layer which contains at least a kind of aromatic amine compound chosen from the compound expressed with  $0 \leq a, b \leq 5, 0 \leq c, d$  and  $e$ , and integer] of  $f=4$ , and contains an electron hole transportation ingredient being a monolayer, respectively.

[0006] [II] — the electroluminescent element which has an electron hole transportation layer containing the luminous layer to which at least one side contains luminescent material and an electron hole transportation ingredient in inter-electrode [ of transparency or a translucent pair ] at least or the luminous layer which contains luminescent material at least, and an electron hole transportation ingredient — it is — as this electron hole transportation ingredient — following general formula (1) – (3) — [Formula 7]



[0007] The inside Ar1 of [type, Ar2, Ar3, Ar4, and Ar5 express the aromaticity heterocyclic compound radical which contains a with a carbon numbers of six or more aromatic hydrocarbon radical or a with a carbon numbers of four or more hetero atom independently, respectively. n shows two or more integers, A1, A2, A3, A4, A5, A6, A7, A8, A9, and the radical as which A10 was chosen from following type (4) – (12) respectively and independently. [0008] [Formula 8]



[0009] (R1 ~R7, R9 ~R11, and R13~R18 are the radicals independently chosen from hydrogen, the alkyl group of carbon numbers 1~12 and an alkoxy group, the aryl group of carbon numbers 6~14 and the aryloxy group, the nitro group, and the aromaticity heterocyclic compound radical, respectively, and when two or more substituents are in the one benzene ring or a pyridine ring, even if they are the same, they may differ.) Independently R8 and R12, respectively Hydrogen, the alkyl group of carbon numbers 1~12, A radical, a, b, c, d, e which were chosen from the aryl group of carbon numbers 6~10, f, g, h, i, j, k, l, m, n, o, and p, respectively Zero<=a, b, g<=5, 0<=c, d, e, f, h, j, k, m and o, p<=4, 0<=i. The organic electroluminescent element characterized by containing at least a kind of aromatic amine compound chosen from the compound expressed with I and integer] of n<=3, and an electron hole transportation layer consisting of a thing which made the high molecular compound distribute this aromatic amine compound. [III] Organic electroluminescent element characterized by consisting of a thing to which the luminous layer made the high molecular compound distribute an aromatic amine compound and luminescent material given in [II]. [0010] Hereafter, the organic EL device of this invention is explained to a detail. In this invention, the well-known thing which is not limited especially as a luminescent material of an organic EL device, for example, is indicated by JP,57-51781,A or 59-194393 official reports, such as coloring matter, such as a naphthalene derivative, an anthracene derivative, a perylene derivative, a poly methine system, a xanthene system, a coumarin system, and a cyanine system, 8-hydroxyquinoline and a metal complex of the derivative, aromatic amine, a tetra-phenyl cyclopentadiene derivative, and a tetra-phenyl butadiene derivative, etc. is usable.

[0011] Furthermore, conjugated-system macromolecule fluorescent substances, such as short Pori (p-phenylenevinylene) of the conjugation chain length of a publication and Pori (2, 5-diheptyl oxy-p-phenylenevinylene), etc. can be used for JP,3-244630,A.

[0012] These luminescent material can form a luminous layer more for adopting suitably the applying methods, such as a well-known approach, for example, vacuum evaporation technique, or a spin coating method of the solution melted into a solvent, the casting method, a dipping method, the bar coat method, and the roll coat method, etc. according to a compound. When luminescent material is not a high molecular compound, it is desirable to use a vacuum deposition method in that delicate control of thickness is performed.

[0013] The electron hole transportation ingredient used for this invention is chosen from the aromatic amine compound expressed with the aforementioned general formula (1), (2), and (3), when it is chosen out of the aromatic amine compound expressed with the aforementioned general formula (1) when the layer containing an electron hole transportation ingredient is a monolayer and an electron hole transportation layer makes a high molecular compound

distribute an electron hole transportation ingredient. In the aromatic amine compound expressed with a general formula (1), Ar1, Ar2, and Ar3 are radicals chosen independently of the aromaticity heterocyclic compound radical which contains a with a carbon numbers of six or more aromatic hydrocarbon radical or a with a carbon numbers of four or more hetero atom independently, respectively. Ar1, Ar2, and Ar3 \*\*\*\* — although it is possible for it to be also a different radical, it is desirable that two or more radicals are the same, and all are more preferably the more nearly same than a composite ease.

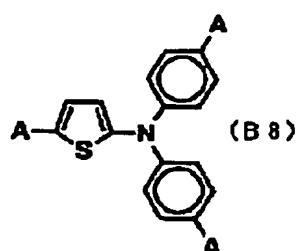
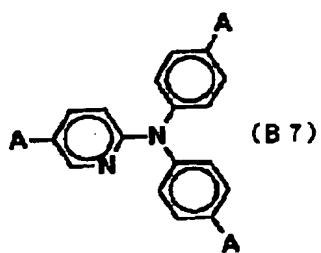
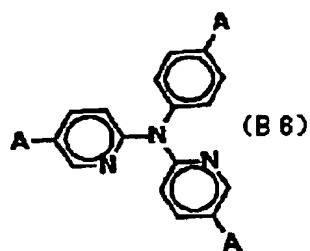
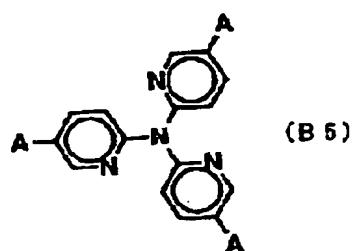
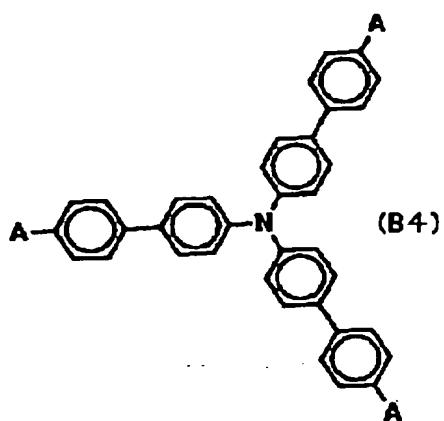
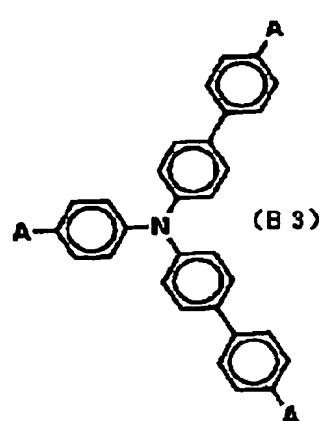
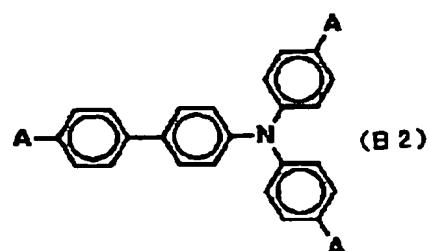
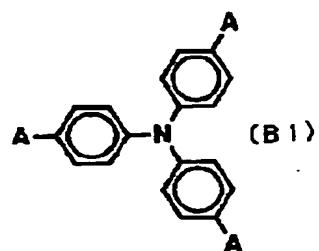
[0014] Ar1, Ar2, and Ar3 If it carries out, as with a carbon numbers of six or more aromatic hydrocarbon Benzene, What was permuted by frames, such as a biphenyl, naphthalene, and an anthracene, two places is illustrated. 1, 4-phenylene, 1, 3-phenylene, 1, 2-phenylene, 4, and 4'-biphenylene, 1, 4-naphthalene-diyl, 2, 6-naphthalene-diyl, 9, and 10-anthracene-diyl are more specifically illustrated. Moreover, what was permuted by frames, such as a thiophene, a pyridine, and a quinoline, two places as an aromaticity heterocyclic compound radical containing a with a carbon numbers of four or more hetero atom is illustrated, and 2, 5-thienylene, 2, 3-pyridine-diyl, 2, 4-pyridine-diyl, 2, 5-pyridine-diyl, 2, 3-quinoline-diyl, 2, and 6-quinoline-diyl etc. is more specifically illustrated. From the ease of composition in the above radical, and a viewpoint that a high-melting compound is given 1, 4-phenylene, 4, and 4'-biphenylene, 2, 6-naphthalene-diyl, 9, 10-anthracene-diyl, 2, 5-thienylene, 2, 5-pyridine-diyl, 2, and 6-quinoline-diyl desirable still more preferably It is 1, 4-phenylene, 4, and 4'-biphenylene, 2, 6-naphthalene-diyl, 9, 10-anthracene-diyl, 2, and 5-pyridine-diyl.

[0015] Furthermore, Ar4 in the aromatic amine compound shown by the general formula (2) and (3) and Ar5 If it carries out, it is an aromaticity heterocyclic compound radical containing a with a carbon numbers of six or more aromatic hydrocarbon radical or a with a carbon numbers of five or more hetero atom. As a with a carbon numbers of six or more aromatic hydrocarbon radical, 1, 2, 4-benzene-Trier, 1, 3, 5-benzene-Trier, 1 and 2, 4-naphthalene-Trier, 1, 3, 5-naphthalene-Trier, 2 and 3, 6-naphthalene-Trier, 3, 5, 4'-biphenyl-Trier, 1, 2 and 4, 5-benzene-tetrayl, 2, 3, 6, 7-naphthalene-tetrayl, 3 and 4, 3', and 4'-biphenyl-tetrayl are mentioned, and 2, 4, 6-pyridine-Trier, 2 and 4, and 6-pyrimidine-Trier are illustrated as a with a carbon numbers of five or more aromaticity heterocyclic compound radical. They are 1, 3, 5-benzene-Trier, 1 and 3, 5-naphthalene-Trier, 2 and 3, 6-naphthalene-Trier, 3 and 5, 4'-biphenyl-Trier, 2 and 4, 6-pyridine-Trier, 2, 3 and 6, and 7-naphthalene-tetrayl among these more preferably.

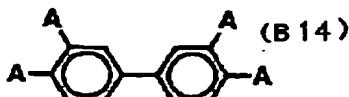
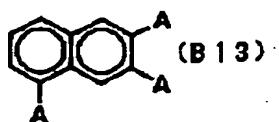
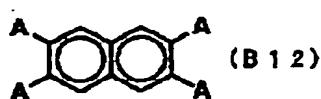
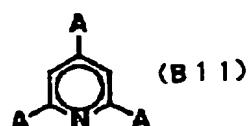
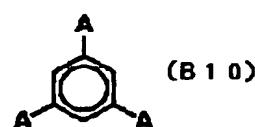
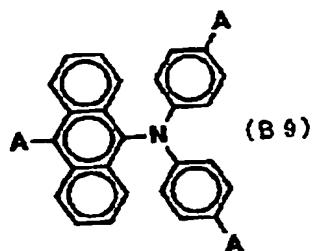
[0016] The diphenylamino radical expressed with general formula (4) - (12) that A1 - A10 described above in the aromatic amine compound shown by the general formula (1), (2), and (3) here, N-carbazolyl radical, a G 2-pyridylamino radical, an N-alkyl-N-phenylamino radical, The N-[3 and 4-pyrimide b] indolyl radical, an N-alkyl-N-2-pyridylamino radical. The N-[4 and 5-pyrimide b] indolyl radical, the N-[2 and 3-pyrimide b] indolyl radical, To the benzene ring of N-phenothiazinyl groups and those radicals, and a pyridine ring, the alkyl and the alkoxy group of carbon numbers 1-12, The radical chosen from the aryl and the aryloxy group, nitro group, and aromaticity heterocyclic compound radical of carbon numbers 6-14 is the derivative by which one or more piece nuclear substitution was carried out. Moreover, R8 and R12 are hydrogen and the alkyl group of carbon numbers 1-12 independently, respectively. A diphenylamino radical with good membrane formation nature, N-carbazolyl radicals, and those derivatives are desirable in these.

[0017] Here, as an alkyl group of carbon numbers 1-12, for example, it is a methyl group, an ethyl group, butyl, an octyl radical, etc., and a methyl group and an ethyl group are desirable. Or as an alkoxy group of carbon numbers 1-12, it is a methoxy group, an ethoxy radical, a propoxy group, a butoxy radical, a pentyloxy radical, a hexyloxy radical, a heptyloxy radical, etc., and a methoxy group and an ethoxy radical are desirable. As an aryl group, a phenyl group, 4-methylphenyl radical, 4-ethyl phenyl group, 4-propyl phenyl group, 4-butylphenyl radical, 4-pentyl phenyl group, As 4-hexyl phenyl group, a 1-naphthalene radical, 2-naphthalene radical, and an aryloxy group, 4-methoxyphenyl radical, A 4-ethoxy phenyl group, a 4-propoxy phenyl group, a 4-butoxy phenyl group, A 4-pentyloxy phenyl group, a 4-hexyloxy phenyl group, a phenoxy group, 4-methylphenoxy radical, 4-ethyl phenoxy group, 4-propyl phenoxy group, 4-butyl phenoxy group, 4-pentyl phenoxy group, 4-hexyl phenoxy group, 4-methoxy phenoxy group, a 4-ethoxy phenoxy group, a 4-propoxy phenoxy group, a 4-butoxy phenoxy group, a 4-pentyloxy phenoxy group, and a 4-hexyloxy phenoxy group are illustrated. As a heterocyclic compound radical, 2-thienyl group, 2-pyridyl radical, 3-pyridyl radical, and 4-pyridyl radical are illustrated. Moreover, the alkyl group used in the N-alkyl-N-phenylamino radical of a general formula (7) and a general formula (9) and an N-alkyl-N-2-pyridylamino radical is an alkyl group of carbon numbers 1-12, and a methyl group and its ethyl group are desirable. The amine compound of a publication is listed to below as a concrete compound. It is the compound expressed with formula B1 -B15 of the following, and is [0018].

[Formula 9]

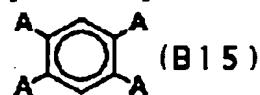


[0019]  
[Formula 10]



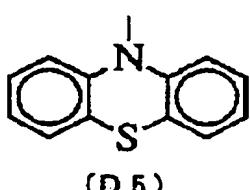
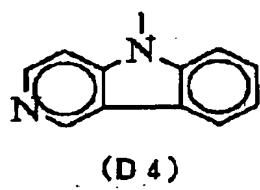
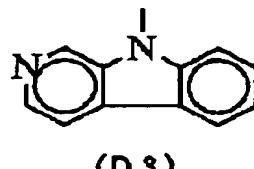
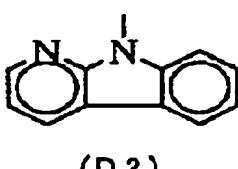
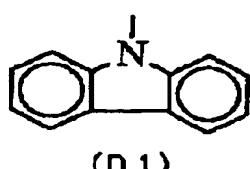
[0020]

[Formula 11]



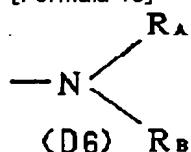
It comes out and A is [0021].

[Formula 12]



Or [0022]

[Formula 13]



It comes out and an expressing thing is mentioned. In addition, what A is expressed with D6 to is RA. And RB The thing of the combination shown in the 1st table of the following is illustrated concretely.

[0023]

[Table 1]

\*\* 1 Table —————— RA —————— RB —————— Phenyl  
 Phenyl 2-methylphenyl 2-methylphenyl 3-methylphenyl 3-methylphenyl 4-methylphenyl 4-methylphenyl 2-ethylphenyl 2-ethylphenyl 3-ethylphenyl 3-ethylphenyl 4-ethylphenyl 4-ethylphenyl 4-tert-butylphenyl 4-tert-butylphenyl 4-methoxyphenyl 4-methoxyphenyl 4-ethoxyphenyl 4-ethoxyphenyl 2-nitrophenyl 2-nitrophenyl 4-(phenyl)phenyl 4-(phenyl)phenyl 4-(2-thienyl)phenyl 4-(2-thienyl)phenyl 4-(4'-methylphenyl)phenyl 4-(4'-methylphenyl)phenyl phenylmethyl Phenyl Ethyl Phenyl 2-methylphenyl Phenyl 3-methylphenyl phenyl 4-methylphenyl Phenyl 2-ethylphenyl Phenyl 3-ethylphenyl Phenyl 4-ethylphenyl Phenyl 4-tert-butylphenyl [0024]

[Table 2]

(Continuation)

Phenyl 4-methoxyphenyl Phenyl 4-ethoxy phenyl Phenyl 2-nitrophenyl Phenyl 2-pyridyl phenyl 4-(phenyl) phenyl phenyl 4-(2-thienyl) phenyl phenyl 4-(4'-methylphenyl) phenylmethyl 2-methylphenyl Methyl 3-methylphenyl Methyl 4-methylphenyl methyl 2-ethyl phenyl Methyl 3-ethyl phenyl Methyl 4-ethyl phenyl Methyl 4-tert-butylphenyl methyl 4-methoxyphenyl Methyl 4-ethoxy phenyl Methyl 2-nitrophenyl Methyl 2-pyridyl Methyl 4-(phenyl) phenylmethyl 4-(2-thienyl) phenylmethyl 4-(4'-methylphenyl) phenylethyl 2-methylphenyl Ethyl 3-methylphenyl [0025]

[Table 3]

(Continuation)

Ethyl 4-methylphenyl Ethyl 2-ethyl phenyl Ethyl 3-ethyl phenyl Ethyl 4-ethyl phenyl Ethyl 4-tert-butylphenyl Ethyl 4-methoxyphenyl Ethyl 4-ethoxy phenyl Ethyl 2-nitrophenyl ethyl 2-pyridyl Ethyl 4-(phenyl) phenyl Ethyl 4-(2-thienyl) phenylethyl 4-(4'-methylphenyl) phenyl 2-pyridyl 2-pyridyl 2-methylphenyl 2-pyridyl 3-methylphenyl 2-pyridyl 4-methylphenyl 2-pyridyl 2-ethyl phenyl 2-pyridyl 3-ethyl phenyl 2-pyridyl 4-ethyl phenyl 2-pyridyl 4-tert-butylphenyl 2-pyridyl 4-methoxyphenyl 2-pyridyl 4-ethoxy phenyl 2-pyridyl 2-nitrophenyl [0026]

[Table 4]

(Continuation)

2-pyridyl 4-(phenyl) phenyl 2-pyridyl 4-(2-thienyl) phenyl 2-pyridyl 4-(4'-methylphenyl) phenyl [0027] Especially the synthesis method of the aromatic amine compound shown by said general formula (1), (2), and (3) is not limited. In order to obtain N, N, and N-triphenylamine derivative among the compounds shown by the general formula (1) as these synthesis methods, it can do [ using the approach of a publication for chemistry Letters 1145 page (1989), or ]. Namely, after adding KI, KIO<sub>3</sub>, and an acetic acid to a triphenylamine and obtaining the iodine permutation object to a phenyl group. The secondary amine compound equivalent to this, the approach of making a carbazole derivative react and compounding, moreover, in order to obtain 1, 3, and 5-tris (diphenylamino) benzene derivative among the compounds shown by the general formula (2) The secondary amine compound equivalent to 1, 3, and 5-triiodo benzene, or the approach of making a carbazole derivative react and compounding. In order to obtain 3, 4, 3', and a 4'-tetrapod (phenylamino) biphenyl derivative among the compounds shown by the general formula (3) 3, 4, 3', and 4' — the secondary amine compound equivalent to — tetra-iodine biphenyl or the approach of making a carbazole derivative react and compounding is illustrated. It is compoundable about other things using this reaction.

[0028] Moreover, since the purity affects a luminescence property when using these compounds as an electron hole transportation layer of an organic EL device, it is desirable after composition to purify reprecipitation purification, sublimation purification, etc.

[0029] The electron hole transportation layer containing the above-mentioned aromatic amine compound can be formed by the well-known approach by the applying methods, such as a vacuum deposition method or a spin coating method of the solution which melted the aromatic amine compound to the solvent, the casting method, a dipping method, the bar coat method, and the roll coat method, etc. In addition, when it thin-film-izes by the applying method, in order to remove a solvent, it is desirable under reduced pressure or an inert atmosphere to heat-treat at the temperature of 60–200 degrees C preferably 30–300 degrees C. It is desirable to use a vacuum deposition method or the LB method in that delicate control of thickness is performed.

[0030] Furthermore, in this invention, it is also possible to mix a known electron hole transportability ingredient to this electron hole transportability aromatic amine compound in the range which does not spoil the purpose of this invention. Although not limited especially as a known electron hole transportability ingredient, a triphenyl diamine derivative, an OKISA diazole derivative, a pyrazoline derivative, an arylamine derivative, a stilbene derivative, etc. can also be used, for example.

[0031] Moreover, in this invention, using the aromatic amine compound of these electron hole transportability as a layer distributed to be carried out through a known macromolecule is also included. Especially as a high molecular compound, although not limited, what does not check electron hole transportability to the degree of pole is desirable, for example, vinyl system polymers, such as Pori (N-vinylcarbazole), the poly aniline and its derivative, the poly thiophene and its derivative, Pori (p-phenylenevinylene) and its derivative, Pori (2, 5-thienylene vinylene) and its derivative, a polycarbonate, a polysiloxane and polymethyl acrylate, polymethylmethacrylate, polystyrene, and a polyvinyl chloride, polyether sulphone, etc. are illustrated. In addition, Pori (N-vinylcarbazole), the poly aniline and its derivative, the poly thiophene and its derivative, Pori (p-phenylenevinylene) and its derivative, Pori (2, 5-thienylene vinylene), and its derivative also have the operation as an electron hole transportability compound here.

[0032] Formation of a mixolimnion with a macromolecule medium can be performed using the above-mentioned applying method, after mixing a macromolecule and this aromatic amine compound in the state of a solution condition or melting and distributing an aromatic amine compound. in this case — although there is especially no limit in the amount of the aromatic amine compound which a macromolecule is made to distribute — the macromolecule 100 weight section — receiving — usually — the 1 – 100 weight section — it is 20 – 70 weight section preferably.

[0033] When precursor macromolecules, such as Pori (p-phenylenevinylene) and its derivative, Pori (2, 5-thienylene vinylene), and its derivative, are used, in the state of a solution, under an inert atmosphere, it heat-treats at the temperature of 60–200 degrees C preferably, and 30–300 degrees C is transformed to a macromolecule after mixing with this aromatic amine compound.

[0034] In this invention, it is also possible to use the aromatic amine compound and luminescent material of said electron hole transportability as a layer distributed to this through the known macromolecule. Although especially the mixing ratio of luminescent material and an electron hole transportability ingredient is not limited, it is the range of 0.1:100-1:1 (weight) preferably, and although especially the ratio of the sum of a macromolecule and these ingredients is not limited, either, it is the range of 100:0.01-1:3 (weight) preferably.

[0035] In this case, the high molecular compound of use is the above-mentioned thing, and what has the not strong absorption to the light is used suitably. Specifically, Pori (N-vinylcarbazole), the poly thiophene and its derivative, Pori (p-phenylenevinylene) and its derivative, Pori (2, 5-thienylene vinylene) and its derivative, a polycarbonate, polymethyl acrylate, polymethylmethacrylate, polystyrene, a polyvinyl chloride, a polysiloxane, etc. are illustrated. Formation of a mixolimnion can adopt the same technique as the above. Moreover, although these layers can be further used with a chisel, the layer of a well-known electronic transportation ingredient may be prepared if needed.

[0036] Furthermore, in this invention, it is also possible to mix and use a known electronic transportability ingredient for this electron hole transportability aromatic amine compound in the range which does not spoil the purpose of this invention. although especially limitation is not carried out as a known electronic transportability compound — full — me — non, well-known things, such as a derivative, an anthra quinodimethan derivative, a diphenyl quinone derivative, a thiopyran dioxide derivative, and an OKISA diazole derivative, can be used.

[0037] The typical structure of the organic EL device of this invention is described below. As structure of a component, the structure of the anode plate / electron hole transportation layer / luminous layer / cathode (it is shown that / carried out the laminating of the layer) described until now or an anode plate / electron hole transportation and a luminous layer (layer of the mixture of an electron hole transportability ingredient and luminescent material) / cathode, and an anode plate / electron hole transportation layer / luminous layer / electronic transportation layer / cathode can also be taken. Moreover, the structure of combination of having a conductive polymer layer (buffer layer) between an anode plate and an electron hole transportation layer can also be taken. That is, the structure of an anode plate / conductive polymer layer / electron hole transportation layer / luminous layer / cathode, an anode plate / conductive polymer layer / electron hole transportation and a luminous layer / cathode, or an anode plate / conductive polymer layer / electron hole transportation layer / luminous layer / electronic transportation layer / cathode can also be taken. The structure where it is desirable in these is the structure of an anode plate / electron hole transportation layer / luminous layer / cathode, an anode plate / electron hole transportation layer / luminous layer / electronic transportation layer / cathode, an anode plate / conductive polymer layer / electron hole transportation layer / luminous layer / cathode, and an anode plate / conductive polymer layer / electron hole transportation layer / luminous layer / electronic transportation layer / cathode.

[0038] Hereafter, taking the case of the thing of the structure of an anode plate / electron hole transportation layer / luminous layer / cathode, the producing method is described below about production of an organic EL device. As transparency or a translucent electrode, transparency or a translucent electrode is formed on transparency substrates, such as glass and a transparent plastic, with the electrode of a pair. Let this be an anode plate. As an ingredient of an electrode, the conductive metallic-oxide film, a translucent metal thin film, etc. are used. Specifically, it is indium tin oxide (ITO) The tin oxide (NESA), Au, Pt, Ag, Cu, etc. are used. As the production approach, a vacuum deposition method, the sputtering method, plating, etc. are used.

[0039] Subsequently, although the aforementioned electron hole transportation layer is prepared, as thickness, 0.5nm - 10 micrometers are 1nm - 1 micrometer preferably. In order to raise current density and to raise luminescence brightness, the range of 2-200nm is desirable.

[0040] Next, although thickness in which a pinhole does not generate the thickness of a luminous layer at least although a luminous layer is prepared on an electron hole transportation layer is required, if not much thick, resistance of a component will increase, and high driver voltage is not needed and desirable. Therefore, 0.5nm - 10 micrometers of 1nm - 1 micrometer of thickness of a luminous layer are 5-200nm still more preferably preferably.

[0041] In addition, also in the mixolimnion of an electron hole transportability ingredient and luminescent material, this range is desirable. Subsequently, an electrode is prepared on a luminous layer. This electrode turns into electron injection cathode. Especially as the ingredient, although not limited, the small ingredient of ionization energy is desirable. For example, aluminum, In, Mg, a Mg-Ag alloy, a Mg-In alloy, a graphite thin film, etc. are used. A vacuum deposition method well-known as the production approach of cathode, the sputtering method, etc. are used. Although the organic EL device of this invention is producible as mentioned above, it is producible by the approach with the same said of the thing of another structure.

[0042]

[Example] Hereafter, although an example explains this invention concretely, this invention is not limited to these.

[0043] an example — one — sputtering — 20 — nm — thickness — ITO — the film — having attached — a glass substrate — an electron hole — transportation — a layer — \*\*\*\*\* — chemistry — Letters — 1145 — a page (1989) — a publication — an approach — having compounded — four — four — ' — four — " — tris (diphenylamino) — a triphenylamine (henceforth, TDATA) — the bottom of the vacuum of  $3 \times 10^{-6}$ Torr — vacuum evaporationo — the thickness of 50nm — having formed membranes . Subsequently, on it, tris (eight quinolinol) aluminum (henceforth, Alq3) was vapor-deposited as a luminous layer, 80nm of 600A of indiums was further vapor-deposited as cathode on it, and the organic EL device was produced. All the degree of vacuums at the time of vacuum evaporationo were  $3 \times 10^{-6}$  to 6 or less Torrs. When electrical-potential-difference 25V were impressed to this component, it is current density 208 mA/cm<sup>2</sup>. A current flows and it is brightness 210 cd/m<sup>2</sup>. Green EL

luminescence was observed. Brightness was proportional to current density. Change of EL luminescence was observed putting in and carrying out the temperature up of this component to a heating incubator. Also in the condition of having exceeded 100 degrees C, the fall of brightness is suppressed by the loose thing and the component using TDATA as an electron hole transportability ingredient continued emitting light.

[0044] TDATA was formed by the thickness of 40nm by vacuum evaporationo under the vacuum of  $3 \times 10^{-6}$ Torr as an electron hole transportation layer to the glass substrate which attached the ITO film by the thickness of 40nm by example 2 sputtering. Subsequently, it is Alq3 as a luminous layer on it. 40nmA and also on it, 200nm (it is Mg:Ag=10:1 at a weight ratio) of magnesium-silver alloys was vapor-deposited as cathode, and the organic EL device was produced. All the degree of vacuums at the time of vacuum evaporationo were  $4 \times 10^{-6}$  to 6 or less Torrs. It is current density when electrical-potential-difference 11V were impressed to this component. 295 mA/cm<sup>2</sup> A current flows and it is brightness. 820 cd/m<sup>2</sup> Green EL luminescence was observed. Brightness was proportional to current density. When EL is observed heating this component in a vacuum, it also sets at 130 degrees C, and they are 12 cd/m<sup>2</sup>. Luminescence was observed.

[0045] Membranes were formed by the thickness of 50nm by carrying out the cast of this weight \*\*\*\* and 0.5% of the weight of the N,N-dimethylformamide solution with a spin coating method, and carrying out reduced pressure drying of TDATA and the poly aniline as an electron hole transportation layer, on the glass substrate which attached the ITO film by the thickness of 20nm by example 3 sputtering. Subsequently, it is Alq3 as a luminous layer on it. Further, on it, 600nm of indiums was vapor-deposited as cathode, and 80nm of organic EL devices was produced. Vacuum evaporationo was performed continuously, without breaking a vacuum. All the degree of vacuums at the time of vacuum evaporationo were  $3 \times 10^{-6}$  to 6 or less Torrs. When electrical-potential-difference 25V were impressed to this component, it is current density 90 mA/cm<sup>2</sup>. A current flows and it is brightness 98 cd/m<sup>2</sup>. Green EL luminescence was observed. Brightness was proportional to current density. Change of EL luminescence was observed putting in and carrying out the temperature up of this component to a heating incubator. Also in the condition of having exceeded 100 degrees C, the fall of brightness is suppressed by the loose thing and the component using TDATA as a charge transportability ingredient continued emitting light.

[0046] Example 4 TDATA:Alq3 : Polycarbonate = it mixed at a rate of 1.75:1.25:7, and \*\*\*\*ed in the chloroform solution 0.5% of the weight. Membranes were formed by the thickness of 170nm by carrying out the cast of this solution with a spin coating method, and carrying out reduced pressure drying by the thickness of 20nm, by sputtering on the glass substrate which attached the ITO film. 600nm of indiums was vapor-deposited as cathode on it, and the organic EL device was produced. Vacuum evaporationo was continuously performed under reduced pressure, without breaking a vacuum. All the degree of vacuums at the time of vacuum evaporationo were  $3 \times 10^{-6}$  to 6 or less Torrs. When electrical-potential-difference 52V were impressed to this component, it is current density 31 mA/cm<sup>2</sup>. A current flows and it is brightness 2 cd/m<sup>2</sup>. Green EL luminescence was observed. Brightness was proportional to current density. Change of EL luminescence was observed putting in and carrying out the temperature up of this component to a heating incubator. Also in the condition of having exceeded 100 degrees C, the fall of brightness is suppressed by the loose thing and the component using TDATA as an electron hole transportability ingredient continued emitting light.

[0047] TDATA was formed by the thickness of 50nm by vacuum evaporationo as an electron hole transportation layer to the glass substrate which attached the ITO film by the thickness of 20nm by example 5 sputtering. Subsequently, it is Alq3 as a luminous layer on it. 40nm (it is Mg:Ag=10:1 at a weight ratio) of 200nm of magnesium-silver alloys was further vapor-deposited for the 4-dicyanomethylene-6-(p-dimethylaminostyryl)-2-methyl-4H-pyran (it outlines Following DCM) as cathode on it by vapor codeposition, and the organic EL device was produced. All the degree of vacuums at the time of vacuum evaporationo were  $3 \times 10^{-6}$  to 6 or less Torrs. When electrical-potential-difference 13V were impressed to this component, it is 2 the current density of 120mA/cm. A current flows and it is brightness. 32 cd/m<sup>2</sup> Red EL luminescence was observed. EL spectrum was in agreement with the fluorescence spectrum of DCM. Brightness was proportional to current density. Change of EL luminescence was observed putting in and carrying out the temperature up of this component to a heating incubator. Also in the condition of having exceeded 100 degrees C, the fall of brightness is suppressed by the loose thing and the component using TDATA as an electron hole transportability ingredient continued emitting light.

[0048] 4, 4', and a 4"-tris (N-carbazolyl) triphenylamine were formed by the thickness of 40nm by vacuum evaporationo as an electron hole transportation layer to the glass substrate which attached the ITO film by the thickness of 40nm by example 6 sputtering. Subsequently, it is about Alq3 as a luminous layer on it. Further, on it, 200nm (it is Mg:Ag=10:1 at a weight ratio) of magnesium-silver alloys was vapor-deposited as cathode, and 40nm of organic EL devices was produced. All the degree of vacuums at the time of vacuum evaporationo were  $4 \times 10^{-6}$  to 6 or less Torrs. When electrical-potential-difference 15V were impressed to this component, it is current density 125 mA/cm<sup>2</sup>. A current flows and it is brightness. 136 cd/m<sup>2</sup> Green EL luminescence was observed. Brightness was proportional to current density. Change of EL luminescence was observed putting in and carrying out the temperature up of this component to a heating incubator. 4, 4', and the component using a 4"-tris (N-carbazolyl) triphenylamine continued emitting light also in 130 degrees C as an electron hole transportability ingredient.

[0049] TDATA was formed by the thickness of 50nm by vacuum evaporationo under the vacuum of  $3 \times 10^{-6}$ Torr as an electron hole transportation layer to the glass substrate which attached the ITO film by the thickness of 40nm by example 7 sputtering. Subsequently, 1, 1, 4, and 4-tetra-phenyl-1,3-butadiene (it omits Following TPB.) is vapor-deposited by the thickness of 20nm as a luminous layer on it, and it is Alq3 as an electronic transportation layer on it. 40nm was vapor-deposited, further, on it, 200nm (it is Mg:Ag=10:1 at a weight ratio) of magnesium-silver alloys

was vapor-deposited as cathode, and the organic EL device was produced. All the degree of vacuums at the time of vacuum evaporationo were  $3 \times 10$  to 6 or less Torrs. When electrical-potential-difference 12.5V were impressed to this component, it is current density 176 mA/cm<sup>2</sup>. A current flows and it is brightness 610 cd/m<sup>2</sup>. Blue EL luminescence was observed. EL spectrum was in agreement with the fluorescence spectrum of TPB. Brightness was proportional to current density. Change of EL luminescence was observed putting in and carrying out the temperature up of this component to a heating incubator. Also in the condition of having exceeded 100 degrees C, the fall of brightness is suppressed by the loose thing and the component using TDATA as an electron hole transportability ingredient continued emitting light.

[0050] 4, 4', and a 4"-tris (G 2-pyridylamino) triphenylamine were formed by the thickness of 40nm by vacuum evaporationo under the vacuum as an electron hole transportation layer to the glass substrate which attached the ITO film by the thickness of 40nm by example 8 sputtering. Subsequently, it is Alq3 as a luminous layer on it. Further, on it, 200nm (it is Mg:Ag=10:1 at a weight ratio) of magnesium-silver alloys was vapor-deposited as cathode, and 40nm of organic EL devices was produced. All the degree of vacuums at the time of vacuum evaporationo were  $4 \times 10$  to 6 or less Torrs. When electrical-potential-difference 18V were impressed to this component, it is current density 19.4 mA/cm<sup>2</sup>. A current flows and it is brightness 152 cd/m<sup>2</sup>. Green EL luminescence was observed. Brightness was proportional to current density. When the electrical potential difference was impressed heating this component in a vacuum, at least 130 degrees C are 44 cd/m<sup>2</sup>. EL luminescence was observed.

[0051] The 4 and 4'-screw (N-(3-methylphenyl) N-phenylamino) biphenyl was formed by the thickness of 50nm by vacuum evaporationo under the vacuum of  $3 \times 10^{-6}$ Torr as a charge transportation layer to the glass substrate which attached the ITO film by the thickness of 20nm by example sputtering of a comparison. Subsequently, it is Alq3 as a luminous layer on it. Further, on it, 600nm of indiums was vapor-deposited as cathode, and 100nm of organic EL devices was produced. Vacuum evaporationo of these each class was continuously performed under reduced pressure, without breaking a vacuum. All the degree of vacuums at the time of vacuum evaporationo were  $3 \times 10$  to 6 or less Torrs. When the electrical potential difference was impressed heating this component in a vacuum, EL luminescence became very weak at 80 degrees C, and at 100 degrees C, light was not emitted at all.

[0052]

[Effect of the Invention] As compared with the conventional thing, thermal stability of the organic EL device using the electron hole transportation ingredient of this invention improves, and it can show the outstanding luminescence property and it can be used for it suitable for displays, such as a source of sheet-like light as a back light, and a flat-panel display.

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[Translation done.]